# PULP & PAPER

C 3975-2

## Crown Zellerbach modernizes Bogalusa, La., linerboard mill 124

## Issue focus: Mill maintenance

# PULP & PAPER

Volume 55 Number 12 December 1981


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**Cover:** This issue focuses on mill maintenance from the practical, hands-on viewpoint—techniques and equipment with a proven track record. (Cover art by Rik Olson.)

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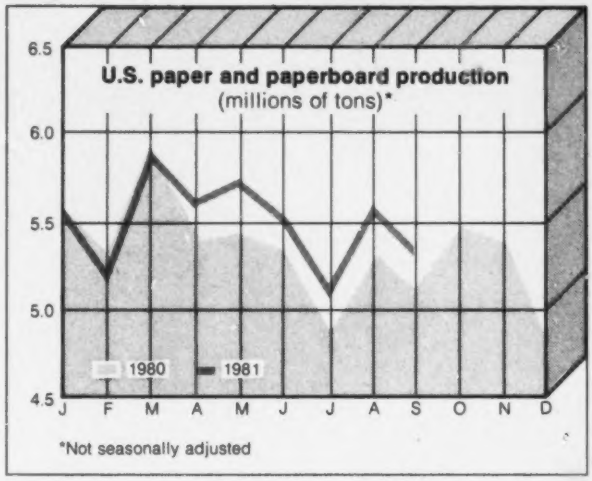
**U.S. paper and paperboard production** came to 5.4 million short tons in September, bringing the seasonally adjusted annual rate for the August-September period to 65.9 million tons, close to the high reached in the first two-month period of the year, according to the American Paper Institute. The steady pattern of paper production contrasts with the weakness shown in some of its major markets.

**Among paper grades,** the strength was concentrated in newsprint and printing/writing papers, with all major grades showing modest increases. The rates of incoming orders as well as the backlog of new orders for printing papers show a weakening trend in demand. The rate of paperboard production continued upward, with major strength in the containerboard grades. The rate of production of solid bleached and recycled board also increased. Production of unbleached kraft linerboard for export, however, declined sharply in September.

**Total Canadian newsprint shipments** reached 708,000 metric tons in September, up 10.3% over the year-earlier levels, according to the Canadian Pulp & Paper Assn. Mill operating rates were 92% vs 90% in September 1980.




| | Latest month (000 short tons) | | % change from year ago | Annualized year-to-date (000 short tons) | % change from year ago |
|---|---|---|---|---|---|
| **PAPER & PAPERBOARD PRODUCTION[1]** | | | | | |
| Newsprint | September | 435 | 11.8 | 5,227 | 12.4 |
| Uncoated groundwood (s) | September | 116 | −4.9 | 1,447 | −3.5 |
| Coated paper (s) | September | 434 | 11.3 | 4,963 | 7.9 |
| Uncoated free sheet (s) | September | 637 | 0.3 | 7,955 | −0.7 |
| Unbleached kraft packaging and industrial (s) | September | 315 | −3.4 | 3,953 | −0.4 |
| Tissue | September | 360 | 1.4 | 4,477 | 2.1 |
| **Total paper** | **September** | **2,568** | **4.6** | **31,291** | **3.7** |
| Kraft linerboard, unbleached | September | 1,220 | 3.4 | 15,018 | 4.5 |
| Semichemical medium | September | 391 | 2.6 | 4,835 | 2.4 |
| Bleached paperboard | September | 319 | 3.6 | 4,029 | 3.4 |
| Recycled paperboard | September | 593 | 3.3 | 7,271 | 3.3 |
| **Total paperboard** | **September** | **2,592** | **2.5** | **32,260** | **3.6** |
| **Total paper and paperboard*** | **September** | **5,351** | **3.1** | **65,966** | **3.3** |
| **PULP, WASTEPAPER & FIBER[2]** | | | | | |
| Total woodpulp production | August | 4,757 | 5.4 | 52,712 | 3.3 |
| Market pulp production | August | 580 | 2.3 | 6,287 | −4.7 |
| Wastepaper consumption at paper/board mills | August | 1,249 | 8.0 | 14,810 | 4.5 |
| Pulpwood consumption (cords) | September | 6,796 | 1.1 | 80,676 | −0.8 |
| **CONVERTED PRODUCTS STATISTICS[3]** | | | | | |
| Corrugated box shipments (billion ft²) | September | 21.094 | 1.1 | 187.093† | 3.7 |
| Containerboard inventories at box plants | Sept. 1 | 2,376 | 6.8 | | |
| **INTERNATIONAL TRADE[2]** | | | | | |
| U.S. paper imports (including products) | August | 619 | −5.9 | 8,343 | −7.5 |
| Imports of Canadian newsprint | August | 499 | −7.2 | 6,902† | −5.0 |
| U.S. paper exports (including products) | August | 356 | −34.9 | 4,892 | −1.1 |
| Exports of unbleached kraft linerboard | September | 128 | −29.7 | 1,904 | −22.4 |
| Exports of woodpulp | August | 212 | −43.5 | 2,948 | −8.2 |
| **CANADIAN STATISTICS[4] (reported in metric tons)** | | | | | |
| Total newsprint shipments | September | 708 | 10.3 | 6,549† | 1.4 |
| Operating rates | September | 92% | 90% | 94% | 95% |
| Inventories held by U.S. consumers | Sept. 30 | 1,467 | 21.0 | | |
| Woodpulp shipments (export only) | September | 479 | −26.1 | 4,966† | −8.9 |
| Operating rates | September | 84% | 86% | 89% | 95% |

1. American Paper Institute. 2. API, Bureau of Census, American Pulpwood Assn. 3. Fiber Box Assn., Paperboard Packaging Council. 4. Canadian Pulp & Paper Assn.
*Includes construction and wet machine grades. †Not annualized. ‡Not directly comparable to year ago because of coding change. (s) = shipments.

FINANCE

# Paper profits still sliding in third quarter

U.S. pulp and paper industry earnings in the third quarter continued their recessionary decline and dipped 2.3% below their depressed year-ago levels on an 8.8% rise in sales, according to a PULP & PAPER survey of 29 companies. Third-quarter after-tax profit margins dropped to 4.6% compared with 6.0% in the second quarter and 5.2% a year earlier.

Even harder hit, however, were eight more companies with large forest products holdings, which saw profits fall 49.3% on a 2.8% rise in sales due to the strangled housing market. Aggregate earnings for the total paper/forest products industry were down 20.7% on a 6.5% rise in sales.

**IP profits down.** "High interest rates and the continued slowdown in housing construction resulted in IP's wood products business being the worst since the housing slump began," said Edwin A. Gee, International Paper Co. chairman and CEO. IP reported profits down 23.6% on a 1% rise in sales, although the paper side of its business held up relatively well.

The story was not much different for other pulp and paper producers. The toll taken by the fall-off in lumber and plywood markets, coupled with the slowdown in forest product exports to recession-impacted Europe and Japan, brought profits below year-ago levels for almost half of all paper companies surveyed. In addition, Crown Zellerbach, Mead, and Scott, with British Columbia operations, were also hurt by the seven-week industry-wide strike in the province during the quarter. Helping several companies, however, were investment and energy tax credits for major capital spending projects, which aided in reducing the 1981 effective tax rate and perking up earnings.

**Demand strength.** Most companies, including Consolidated Papers, Fort Howard, St. Regis, and Scott, reported that demand remained strong during the quarter for newsprint, coated printing/writing grades, and tissue, helping price hikes in these grades to go through. A slowdown was seen, however, for lightweight coated and uncoated paper grades during the quarter, as well as for packaging grades and hardwood pulp.

Several companies also reported a fall-off in demand for linerboard and bleached board by the end of the quarter, and Union Camp Corp. reported taking several days' downtime at its Savannah, Ga., and Montgomery, Ala., mills as a result.

The general near-term outlook is gloomy, as the housing construction industry is not expected to improve until mortgage interest rates come down dramatically—and that is not foreseen until at least the second quarter of 1982. In the meantime, the cost/price squeeze which has been building in packaging products is expected to continue into the fourth quarter.

**Canadian profits tumble.** Canadian paper company profits, continuing to be hurt by the depressed housing market, were further slashed by the seven-week strike in British Columbia, and tumbled 52.3% below year-ago levels on a 0.9% rise in sales. Three companies, B.C. Forest Products, B.C. Resources, and MacMillan Bloedel, took actual losses for the quarter.

Abitibi-Price, however, reported a five-fold increase in earnings over the third quarter of 1980, when most of its pulp and paper operations were crippled by strikes. And Consolidated-Bathurst registered a 9.1% increase in earnings, while Great Lakes Forest Products matched its year-earlier performance.

## U.S. PAPER/FOREST PRODUCTS RESULTS

| | Third quarter (000 dollars) | | | |
|---|---|---|---|---|
| **Paper companies** | **Sales** | **Change 1981/80** | **Earnings[1]** | **Change 1981/80** |
| Chesapeake | $87,483 | 13.1% | $7,812 | 20.3% |
| Clevepak | 29,900 | 14.1 | 1,270 | 162.9 |
| Consolidated | 133,273 | 7.2 | 12,038 | −1.2 |
| Crown Zellerbach | 790,400 | 0.4 | 6,900 | −21.6 |
| Diamond | 318,700 | 4.6 | 5,400 | −41.4 |
| Federal Paper | 118,595 | 11.6 | 6,162 | −2.4 |
| Fort Howard | 129,724 | 19.0 | 22,834 | 26.9 |
| Glatfelter | 72,208 | 17.9 | 4,058 | −14.9 |
| GN Nekoosa | 375,700 | 8.0 | 22,700 | −3.8 |
| Hammermill | 303,467 | 19.1 | 8,176 | 24.1 |
| Int'l. Paper | 1,271,800 | 1.0 | 54,000 | −23.6 |
| James River (7/26)[2] | 178,022 | 128.6[3] | 4,217 | 1273.6[3] |
| Kimberly-Clark | 713,700 | 8.7 | 42,600 | −3.0 |
| Longview (7/31)[2] | 102,231 | 15.6 | 4,986 | n.m.[4] |
| Mead | 760,365 | 9.9 | 22,493 | −30.7 |
| Mosinee | 22,824 | 21.6 | 1,804 | 79.1 |
| Pentair | 55,605 | 8.1 | 2,213 | −15.5 |
| St. Regis | 707,649 | 3.3[5] | 43,235[6] | 4.3[5] |
| Scott | 575,154 | 18.5 | 25,935 | 573.3 |
| Sonoco | 131,160 | 14.8 | 8,687 | 0.3 |
| Sorg | 22,410 | 20.4 | 581 | 423.4 |
| SW Forest | 193,030 | 7.0 | 1,664 | −81.7[7] |
| Stone Container | 101,963 | 10.8 | 6,420 | 43.3 |
| Union Camp | 430,607 | 7.3 | 44,362 | 8.0 |
| Wausau (8/31)[2] | 196,544 | 20.1 | 2,650 | −60.6 |
| Westvaco | 392,695 | 12.5 | 25,395 | 26.4 |
| Willamette | 249,812 | — | 3,743 | −82.5 |
| **Total** | **8,465,021** | **8.8** | **392,335** | **−2.3** |
| **Forest products** | | | | |
| Arcata | 183,726 | −4.2 | 4,692 | −24.0 |
| Boise Cascade | 781,480 | 2.3[5] | 18,470 | −37.0[5] |
| Champion Int'l. | 1,008,839 | 5.5 | 24,465 | −51.0 |
| Georgia-Pacific | 1,400,000 | 9.4 | 31,000 | −58.1 |
| Louis.-Pacific | 254,410 | −14.8 | (2,550) | n.m. |
| Pope & Talbot | 52,994 | −5.1 | (698) | n.m. |
| Potlatch | 225,134 | 7.4[5] | 6,595 | −49.8[5] |
| Weyerhaeuser | 1,097,150 | −1.3 | 50,052 | −27.3 |
| **Total** | **5,003,733** | **2.8** | **132,026** | **−49.3** |
| **U.S. total** | **13,468,754** | **6.5** | **524,361** | **−20.7** |

## CANADIAN PAPER INDUSTRY RESULTS

| | | | | |
|---|---|---|---|---|
| Abitibi | C$453,358 | 73.3 | C$33,585 | 509.1 |
| B.C. Forest | 128,900 | −40.8 | (14,300) | n.m. |
| B.C. Resources | 167,500 | 52.3 | (2,100) | n.m. |
| Con-Bathurst | 379,086 | 14.4 | 27,967 | 9.1 |
| CZ Canada | 136,000 | −21.8 | (2,500) | n.m. |
| Domtar | 473,700 | 11.8[5] | 17,700 | −26.6[5] |
| Fraser | 114,511 | 33.0 | 4,296 | −39.0 |
| Great Lakes | 429,295 | 5.3 | 61,554 | 0.0 |
| Mac. Bloedel | 363,300 | −40.1 | (38,400) | n.m. |
| **Total** | **2,645,850** | **0.9** | **87,902** | **−52.3** |

1. Income after taxes, from continuing operations, excluding most significant nonrecurring items in both years. 2. Period ended. Figures for James River are for first quarter, Wausau are for fourth quarter. 3. Reflects acquisition of Brown Co., final in October 1980. 4. Reflects income loss in 1980. 5. 1980 figures restated by company. 6. Reflects acquisition of Drum Financial Corp., final in September 1981. 7. Reflects $2.8-million gain from assets sale in 1980. n.m. = not meaningful.

# Corrugated box shipments to rise

## Similar growth in box shipments seen for next year, but longer-run outlook may be dampened by liner shortfall looming in 1983-84, FBA meeting told

**By WILL MIES, News and Business Editor**

☐ Corrugated box shipments are headed for their second-best year on record despite some weakness in the final quarter of 1981, and should reach a new high in 1982, speakers told Fibre Box Assn.'s Oct. 21-23 annual meeting in San Francisco.

Shipments of boxes in 1981 are expected to hit 249.2 billion ft², up 3.2% from last year's depressed level, and are only about one-half percent below 1979's peak of 250.6 billion ft², **Thomas J. Muldoon**, FBA executive vice president, noted.

And next year, box shipments should rise by 3.0% to 256.6 billion ft² as the economy picks up momentum in the second half, helped by a turnaround in consumer spending, predicted **S.P. Moscarello**, vice president of Merrill Lynch Economics.

Shipment increases could accelerate further in 1983 and 1984, but casting a shadow over this rosy picture is a possible linerboard shortfall those years, **W.A. Copeland**, president of Copeland Economics Group Inc., indicated in his remarks to about 50 industry executives attending the meeting.

### Seasonal pattern disappears

"For many years, the corrugated box industry followed a pattern of high volume in the spring and fall, with lower volume in the summer and winter months," stated Muldoon, "but for the last several years this has not been true. The basic economic forces in the country have altered the traditional seasonal pattern."

In 1979, shipments in the first two quarters were at the same volume level; and the third and fourth quarters, while lower, were also practically the same, he noted. Then in 1980, the first quarter was not only the highest first quarter on record, but the highest of any quarter in the history of the industry. The second and third quarters were down, followed by the beginning of a recovery in the fourth quarter (Figure 1).

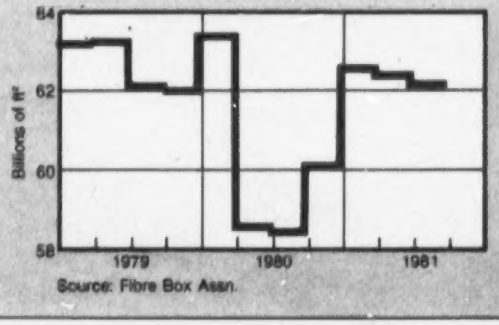
In 1981, shipments "just lumped along, with each month and each quarter being about the same as the period before," Muldoon continued. First quarter shipments were down just 1.4% from the all-time-high first quarter of 1980, while the second quarter had a year-to-year increase of 6.5%, followed by a 6.4% rise in the third quarter. "These gains were not due to any great increase in shipments, but rather to the low level of shipments last year." Fourth-quarter forecast is for a 1.9% gain, resulting in an overall 1981 increase of 3.2%, the FBA executive indicated.

### Sun Belt leads in shipments growth

"The largest growth in corrugated box shipments over the 1970-80 period has been in the Sunbelt areas, reflecting the migration of industries to the South and West," Muldoon noted. The Southeast has had the greatest growth, an increase of almost 65% over the ten-year span, for about a 6%/year compounded average. The South Central and Western states each had strong increases of 48%, while the smallest increase was in the East Central states, with a ten-year gain of only 4.9%, well under one-half percent/year.

Comparing 1980 to 1979, Muldoon said all areas registered declines. The Pacific Coast region almost matched its 1979 shipments with a decline of just 0.1%, while the Southeast and South Central were identical at −0.7%. The Northeast and North Central states were almost the same at −5.2% and −5.3%, respectively, while the East Central states—which are heavy in automotive parts and appliances industries—suffered the most, down 10.1%.

Figure 1. **U.S. corrugated box shipments by quarters, 1979-81**




Source: Fibre Box Assn.

# 3.2% in '81 despite soft economy

Through the first three quarters of 1981, all geographic areas have registered shipment increases, Muldoon said. South Central has had the largest gain of 6.7%, followed by the East Central area, the most depressed area last year, with a 5.9% increase. The Pacific Coast was up 5%, while the smallest gain was in the Northeast with a rise of just 0.5%. Total industry shipments through the first nine months of this year were 3.7% better than in the same period of 1980.

### Shipments diverge slightly from FRB index

Corrugated box shipments tracked the Federal Reserve Board's index of industrial production all through 1979 and the first few months of 1980, then both dived at almost the same time, Muldoon said.

Then box shipments turned up before industrial production did, and their ratio remained in the range of 101 to 103 in the later months of 1980 and up to February of this year. The ratio then dropped in the spring of 1981 as industrial production was inching upward, "probably indicating some inventory liquidation in anticipation of a business downturn." Since June, Muldoon noted, the ratio has been moving upward again.

### Weakness in corrugated price trend

FBA's corrugated price index increased quarter by quarter through 1979 and the first and second quarters of 1980. In second-quarter 1980, the index reached 214, then in the third quarter dropped slightly to 213, but went back to 214 in the fourth quarter (Figure 2).

The first quarter of 1981 saw a 4% rise to 223, and in the second a further rise of 4.4% to 233, but in the third quarter the index dropped one point, the same as happened in 1980, he noted. Since the first of the year, the price index has increased by 8.4%.

Comparing the corrugated price index with the government's producer price index, Muldoon said that "the gap between the two has been widening." In the first two quarters of 1979 the difference was 45 points, with the spread gradually increasing to 65 points in the fourth quarter of 1980.

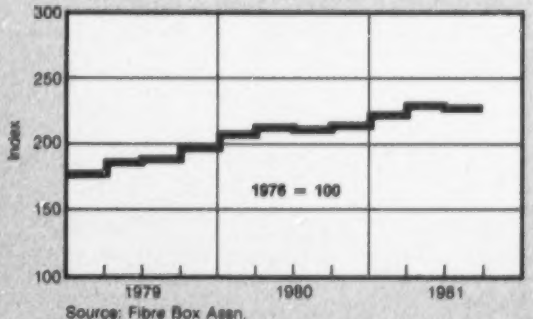
The corrugated index kept up in the first quarter of 1981, when the gap remained at 65 and the spread narrowed somewhat in the second quarter to 61 points. But in the third quarter the difference increased again to 64 points, Muldoon said.

### Containerboard inventories climb

Unbleached kraft linerboard mills ran at about 98% of capacity in 1979 and kept up that pace through the first half of 1980, averaging about 97%, according to Muldoon. But as exports began to decline late in 1980, containerboard inventories at box plants and mills began to climb. Mills cut back their production, bringing the operating rate for the year down to 96% (Figure 3).

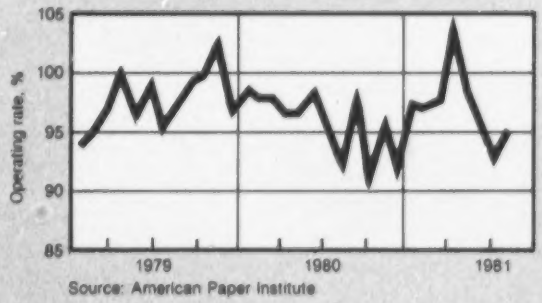
"The mills started 1981 with a bang, shooting over the 100% mark in April," Muldoon said. As a result of weak export demand, containerboard inventories have been rising steadily since February, from 1.96 million tons

Figure 2. **Corrugated box price index, 1979-81**




Source: Fibre Box Assn.

Figure 3. **Unbleached kraft paperboard mill operating rates, 1979-81**




Source: American Paper Institute

that month to 2.45 million tons Oct. 1. Weeks of supply rose from 5.5 weeks in Feb. 1 to 7.0 weeks on Aug. 1, but declined to 6.7 weeks at the beginning of October due to a higher usage level (Figure 4).

### Consumer-led economic recovery

Softness in the economy should extend from the fourth quarter into the first quarter of 1982, according to Moscarello of Merrill Lynch, which provides forecasts for FBA. But the economy should begin to recover in the second half of next year, and the key variable "will be the consumer coming back to the marketplace," he said.

For several years, real disposable income has been declining as inflation—as measured by the consumer price index—has outstripped personal income gains. But next year the inflation rate is expected to moderate, resulting in a turnaround in real disposable income and retail sales.

One major cause for optimism on the inflation front comes from energy costs, Moscarello noted. While the cost of a barrel of imported crude oil soared 70% in 1979 and 40% in 1980, its cost this year rose a mere 5% to 6% and should not go up much more than that in 1982.

In this economic environment, corrugated box shipments are expected to show increasing strength as 1982 progresses, starting off with a 0.7% first quarter decline from year-earlier levels, followed by gains of 3.9%, 3.0%, and 5.7% for the remaining three quarters, for a full-year increase of 3.0% to 256.6 billion ft² (Table 1).

On a regional basis, Moscarello projected the Southeast would register the largest gain in shipments next year at 4.8%, while other parts of the country would show increases ranging from 2.1% in the North Central states to 2.9% in the South Central region.

As for end-use markets, fastest growth in corrugated box shipments in 1982 is projected for chemicals (+6%), household appliances (+6%), plastics (+4%) and fabricated metals (+4%). Food and beverage—largest end-use market—is projected to show a 3% gain in shipment volume, while slower volume growth is expected in the paper, furniture and stone, clay and glass industries.

### Tight liner market forecast

A somewhat more upbeat projection on corrugated box shipments was presented by Copeland, who estimated that shipments would rise 3.8% this year to 250.6 billion ft², and 4.4% in 1982 to 261.6 billion ft², then will rise by more than 5.5% in 1983 and 5.9% in 1984 to 292.3 billion ft².

Based on these shipment levels, he projected containerboard production for domestic use would rise by 5.6% to 19.1 million tons in 1981 and 4.7% to 20.0 million tons in 1982. Exports of both linerboard and medium, however, are expected to drop 30.7% to 1.87 million tons, then rise 26.5% to 2.37 million tons in 1982—and not approach 1980's record 2.70-million-ton level until 1984. One reason for the surge in export business last year was China, which Copeland expected would buy about 200,000 tons of linerboard from the U.S. in 1982.

Because of the downturn in exports, unbleached kraft linerboard production in 1981 is expected to rise by only 1.1% to 15.5 million, but then jump by 5.1% to 16.2 million tons in 1982. With planned capacity additions each year of roughly 3.5%, Copeland forecasts operating rates will fall from 96% in 1980 to 94% in 1981, and then partially recover to 95% in 1982.

But with a 5.9% jump in production to 17.2 million tons projected for 1983 and only 0.5% capacity growth, operating rates will exceed 100%, and stay above that level in 1984, according to Copeland.

He does not expect any surge in new capacity to alleviate the probable shortfall, partly because of the long leadtime in building new mills, and also because return on new linerboard investments is not that attractive. And more than 300,000 tpy of existing liner capacity could even disappear if International Paper Co. decides to convert its Georgetown, S.C., paperboard mill to white paper and bleached market pulp.

Copeland estimated the current total U.S. mill cost for producing unbleached kraft linerboard, which sells for $300/ton, at about $270/ton, resulting in an average gross margin of $30/ton.

This puts U.S. producers at a favorable advantage compared to competitors in Sweden, whose average margin on linerboard production is estimated to only be about $5/ton. But the profit from producing linerboard is considerably less than what U.S. paper companies could make on producing other grades like market pulp, with a gross margin of $140/ton, or newsprint, with a margin of $100/ton. "When corporate management looks at available opportunities, they will have such comparisons in mind," Copeland said. □

Figure 4. **Containerboard inventories at box plants and mills, 1979-81**

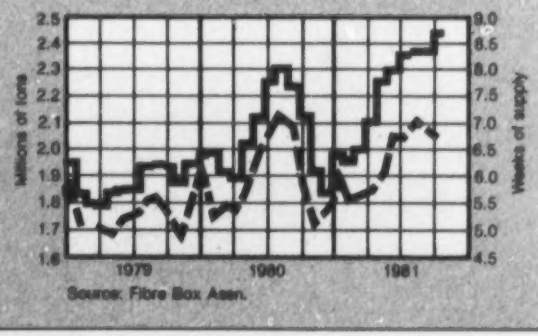



Table 1. **Projected corrugated box shipments by quarter, 1981-82**

| Quarter | 1981 shipments (billions ft²) | % change from '80 | 1982 shipments (billions ft²) | % change from '81 |
|---|---|---|---|---|
| 1st | 62.568 | −1.4% | 62.099 | −0.7% |
| 2nd | 62.353 | +6.5 | 64.783 | +3.9 |
| 3rd | 62.172 | +6.4 | 64.058 | +3.0 |
| 4th | 62.087e | +1.9 | 65.629 | +5.7 |
| Year | 249.180e | +3.2 | 256.569e | +3.0 |

e = estimated
Source: Fiber Box Assn. and Merrill Lynch Economics

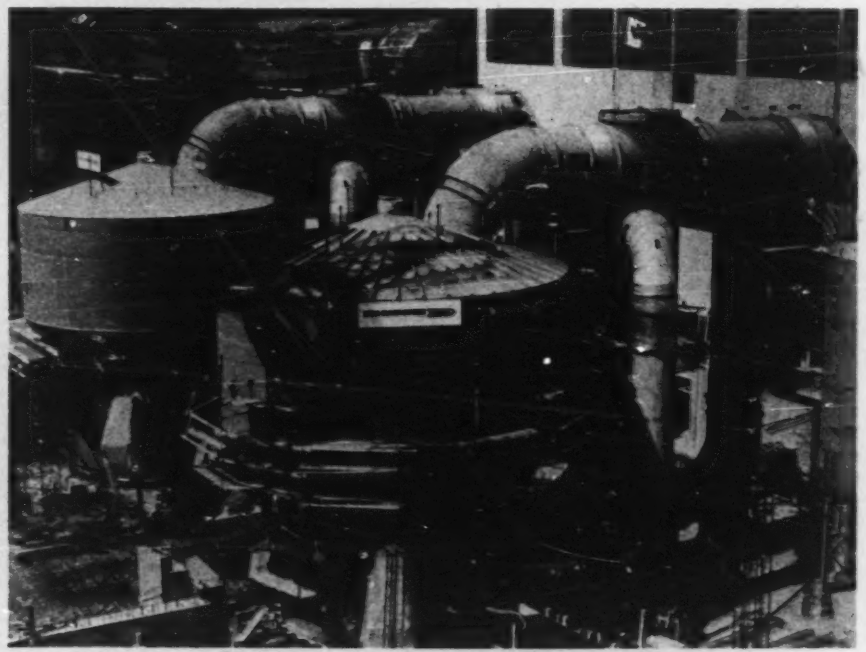
# Sludge disposal by combustion offers potential energy source

Secondary sludge can be dewatered using coal as a filter medium, and burned in a steam generator; process offers short payback

By JURGEN H. KLEINAU

Table 1. Energy perspectives

| | Energy usage in Btu/$ GNP (1979 basis) | Pulp, paper industry % Purchased fuel and energy |
|---|---|---|
| 1972 | | 59.1 |
| 1973 | 36,500 | |
| 1979 | 33,000 | 52.7 |
| 1980 | 32,700 | 52.4 |



Sludge combustion with steam generation.

□ The pulp and paper industry has made substantial advances toward becoming self-sufficient in energy supply. This self-sufficiency is as much the result of greater utilization of process waste for fuel as from conservation efforts. Nationally, these conservation efforts have resulted in a measurable reduction in energy usage relative to gross national product (Table 1).

The industry has also made enormous strides in effluent treatment, resulting in an increased quantity of waste-treatment sludges to be handled. Disposal of these sludges is often as expensive as the waste-treatment process itself, and can consume large quantities of energy. Thus, it is important that the cost and energy consumption of sludge disposal not outweigh the benefits gained in waste-treatment operations.

## Sludge as a fuel

Ignoring the much more specialized conditions prevailing in mills producing high-ash coated grades, or ones utilizing deinking operations, the primary and secondary water-treatment sludges generated from pulping and papermaking operations consist predominantly of organic substances. The organic substances are combustible; thus, a conceptual approach to the disposal of sludge should consider sludge as a fuel and not waste. Approximately 6000 to 11,000 Btu/lb of organics are lost if sludge is landfilled. Only the high water content of secondary sludge prohibits the practice of this concept; therefore, sludge should be thought of as a dewatering problem, and not a disposal problem.

*(Continued)*

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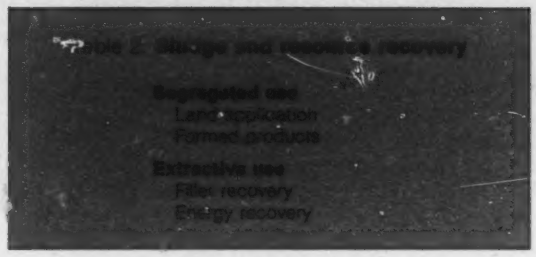
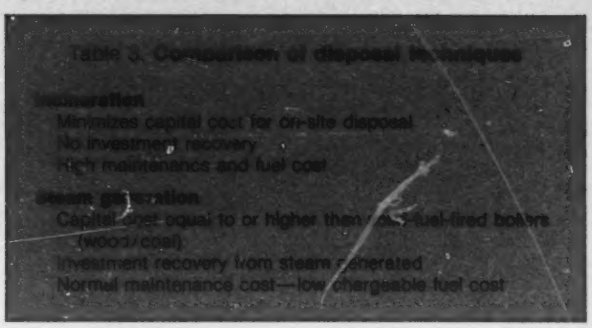




Because the dewatering problem is such a formidable one (especially for secondary sludges), industry has generally preferred to use the least capital-intensive disposal mechanism available—which is land application, primarily in the form of lagooning. Enormous variety exists in the details of different designs for sludge disposal, but fundamentally there are only four distinctly different methods (Table 2). Fiber recovery is purposely not mentioned in this context because it should be considered a means of improving internal process efficiency.

Energy recovery from sludge requires combustion. Incineration has been considered as a possible means of sludge combustion for many years. However, there have been few satisfactory experiences with this process. Designers have tried to improve the economics of sludge disposal through incineration by minimizing capital requirements. However, this approach is not consistent with the characteristics of a sludge combustion system designed for steam generation (Table 3). A steam-generation system for sludge combustion will have a capital cost equal to other solid-fuel-fired systems, but it will have a substantial return on investment. By contrast, an incineration system will always have a net cost.

Municipalities, with enormous wastewater treatment sludge-disposal problems, have begun to design for steam generation from sludge-combustion installations, especially when disposal of proportionately large quantities of secondary sludge is necessary. The economics of generating steam from sludge combustion in a sewage treatment plant are quite favorable. Retrofitting existing plants with waste-heat boilers is even more attractive, since payout time calculated on the waste-heat boiler alone can be as short as a few months.

## Dewatering problems

Biological waste-treatment sludges contain large quantities of intracellular water which cannot be removed by mechanical dewatering. Special process steps such as anaerobic digestion, freeze drying, wet-air oxidation, and aerobic digestion can be employed to break cell walls, making additional water removal by mechanical dewatering possible. However, none of these processes remove all water from the sludge. Substantial quantities of water would still be carried into a combustion process if such pretreatment systems are used.

Alternatively, all water can be removed from sludge either by using evaporative processes or by allowing water to be evaporated in the combustion process itself. Pre-evaporation techniques have been successfully employed in the form of scraped surface evaporators and solvent carrier systems. Systems that are still in the development stage will provide for evaporation of sludge moisture in dryers utilizing fluegas or combustion-system solids as the drying medium.

The direct heat requirements for water removal from sludge vary substantially with the evaporation system chosen (Table 4). A careful specific analysis should be made to compare operating costs with capital-investment requirements for each system. The more energy-efficient a system is, the higher its capital cost.

The energy loss incurred when evaporating water in a sludge combustion system actually is quite nominal at the 1400-Btu/lb of water level (Table 4). In fact, the only actual loss of energy is the latent heat of vaporization of the water, plus the remaining low sensible heat in the water vapor leaving the steam generator at fluegas exit temperature. Sensible heat from burning the sludge organics, and from the support fuel, is recovered as steam.

## Coal as a filter medium

In the past, sludge systems have been operated using expensive filter aids to improve dewatering, and expensive fuels, such as oil or natural gas, as support fuel. Thus, total operating costs easily became unacceptably high. A readily available and low-cost material which can be used as a filter aid and as a fuel is coal. Sludge filtration and vacuum incineration with pulverized coal has been reported. Full-scale trials, conducted in existing equipment retrofitted with the necessary material-handling systems, support earlier research work, and indicate that a practical operation has been achieved.[2]

One remaining concern is the $SO_2$ emission resulting from burning most coals. Adding a fluegas desulfurization system to a sludge combustion installation would result in another add-on process, additional capital investment and operating costs, and possibly another sludge-disposal problem. An alternative method is to use the demonstrated concept of capturing sulfur released from burning coal with limestone added to a fluidized-bed, combustor/steam generator.

A very simple process results from the combination of these concepts (Figure 1). Finely ground coal (less than $^1/_{16}$ in.) is mixed with sludge, which is dewatered mechanically on conventional equipment. The filter cake is then used as fuel in a fluidized-bed steam generator. Limestone added to the steam generator retains sulfur from the coal in the ash as calcium sulfate.

Reported research indicates that the sludge-cake dryness obtained using coal as a filter aid is more than adequate to reach the concentrations necessary for using the sludge cake as fuel (Table 5). For example, when 0.2 lb of coal are added to sludge for each pound of sludge sol-

Table 4. Energy used to remove water from sludge

| Process | Btu/lb of water |
|---|---|
| Double-effect evaporation | 950 |
| Triple-effect evaporation | 600 |
| Flueges dryer at 250°F (without steam generation) | 1200 |
| Burning in boiler with economizer or air heater | 1400 |

Table 5. Sludge cake dryness obtained with coal

| Coal added (lb/lb sludge solids) | Cake (% dry solids content) | % dryness required for fluidized-bed combustion |
|---|---|---|
| 0.1 | 22 | 25 |
| 0.2 | 24 | 23.5 |
| 0.3 | 26 | 22.5 |
| 0.4 | 28 | 22 |

Table 6. Projected economics of proposed steam from sludge system

Sludge: 22,000 lb/hr at 20% solids (28% with coal as filter aid)

| | |
|---|---|
| **Annual operating costs** (8000 hr) | |
| Fuel, 2640 lb/hr at $0.02/lb ($45/ton) | $ 480,000 |
| Power, 400 kw at $0.03/kw | 96,000 |
| Disposal of ash, 2.4 ton/hr at $3.64/ton | 69,000 |
| Labor | 60,000 |
| Maintenance | 60,000 |
| | $ 765,000 |
| **Credits** | |
| Disposal of sludge, 22 ton/hr at $3.64/ton | $ 640,000 |
| Steam, 16,700 lb/hr at $5/million Btu | 670,000 |
| | $1,310,000 |
| **Available for indirect costs** | $ 545,000 |

ids, the dry-cake solids content can be expected to reach 24%. A 23.5% level is required for this cake to become a fuel with stable combustion characteristics. Specific data must be developed for each type of coal and sludge involved. There will also be minor heat requirements for calcination of the limestone added for sulfur control.

The technology of $SO_2$ control by limestone addition to fluidized-bed coal-fired boilers has been well documented (Figure 2). The amount of limestone required for control of a given fuel sulfur content and $SO_2$ control requirements is highly dependent upon several variables. The nature of the limestone itself is probably the most important variable, but combustion temperature, solids-retention time in the boiler, and gas-retention time in the boiler must be considered.

Projected economics for the system, as described in this article (Table 6) were estimated on the basis of 1980 costs. Indications are that economic credits occurring from this system (by way of reduced cost of sludge disposal and the value of steam generated) will provide for a return on investment which cannot compete with that obtained from building disposal plants which make a salable product. However, these economic credits will be very attractive compared with a disposal system (landfilling) which provides no return at all. □

Figure 1. Simplified sludge-to-energy system

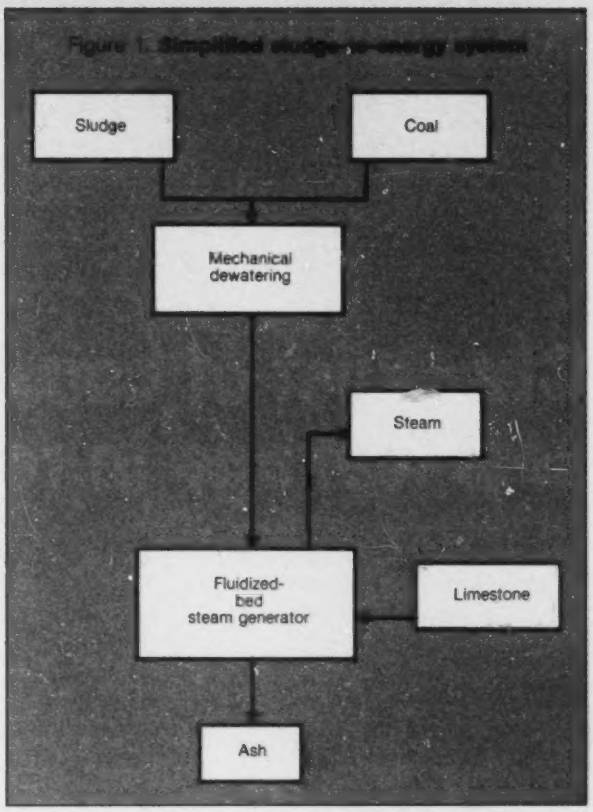
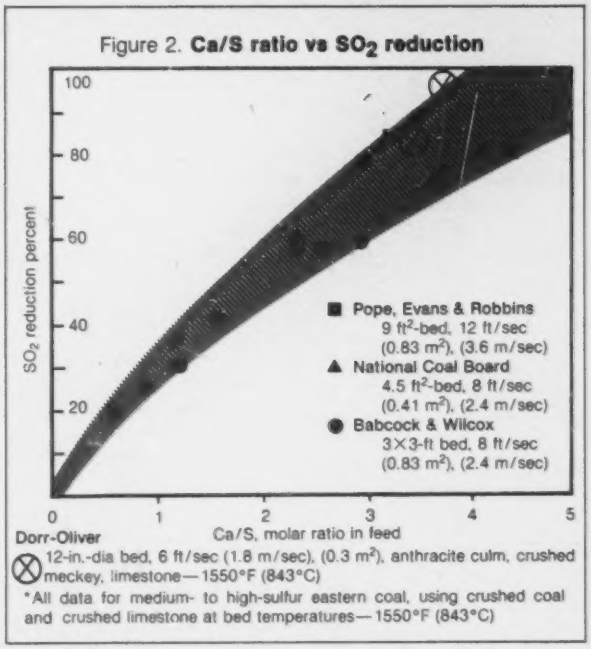



Figure 2. **Ca/S ratio vs $SO_2$ reduction**




*All data for medium- to high-sulfur eastern coal, using crushed coal and crushed limestone at bed temperatures—1550°F (843°C)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1. S.W. Hathaway, R.A. Olexsey, *Journal, Water Pollution Control Federation*, Dec. 1977, pp. 2419-2430

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# Hydrogen peroxide usage growing, prices stable

By BARRY SHOCKETT

The outlook for hydrogen peroxide ($H_2O_2$) appears to be bright through the end of the decade in both the U.S. and Canada. Demand is expected to continue to grow due to both new end uses developed over the past five years (such as in-situ uranium mining and geothermal energy production), and the growth in most other areas. In the paper industry, increased groundwood and TMP capacity, and the use of more recycled newsprint will result in high demand for the bleaching agent. It is also being used in some southern U.S. mills as a partial replacement for chlorine and chlorine dioxide in bleaching chemical pulp.

Canadian $H_2O_2$ consumption in 1981 is up, as a result of a relatively strong performance by the newsprint sector.

**U.S. statistics for hydrogen peroxide**

| | 1978 | 1979 | 1980 | 1981 |
|---|---|---|---|---|
| | (000 short tons) | | | |
| Nameplate capacity | 136 | 143* | 197.25** | 193 |
| Production | 107.5 | 104.5 | 130 | 140 |
| Consumption, apparent | 110 | 114 | 122.5 | 130 |
| Pulp bleaching | 17.5 | 18.25 | 20 | 21.5 |
| Exports | 10 | 9 | 13.5 | 15 |
| Imports | 12.5 | 18.5 | 6 | 5 |

*Including prorated capacity of Interox America's 44,000-tpy plant, on-stream in November 1979
**Including prorated capacity of Shell's 17,000-tpy facility, closed in March 1980

**Canadian statistics for hydrogen peroxide**

| | 1978 | 1979 | 1980 | 1981 |
|---|---|---|---|---|
| | (000 short tons) | | | |
| Total demand | 5.4 | 5.8 | 7.4 | 8.3 |
| Pulp bleaching | 3.1 | 3.4 | 5 | 5.7 |
| Miscellaneous* | 2.25 | 2.35 | 2.35 | 2.55 |
| Imports | 5.4 | 6.2 | 6.8 | 8.3 |

*Includes textile bleaching and water treatment

## HYDROGEN PEROXIDE

### UNITED STATES

**Uses:** $H_2O_2$ is used for bleaching chemical and mechanical pulps and in the deinking of recycled newspaper. Largest end-use is chemical synthesis (28%). Other applications include waste and water treatment, textiles, and mining.

**Demand:** In 1981, the paper industry will consume 21,500 tons, or 15% of the total 140,000 tons produced. This is up from 20,000 tons in 1980.

**Sources:** The four U.S. producers in decreasing order by capacity are: DuPont, FMC, Interox America, and PPG. In 1979, imports accounted for 16%, up from 11.5% in 1978. In 1980, imports dropped drastically due to increased domestic capacity (FMC and Interox).

**Availability:** 1981, market; 1980, market; 1979, market; 1978; market.

**Pricing:** The bulk price for 70% solution, posted in January 1981, is unchanged at 39.5¢/lb f.o.b producing point, freight-equalized. 1980, 35.5¢-36.5¢/lb; 1979, 32.5¢/lb.

**Forecast:** Paper industry demand should grow about 8%/year. Growth in bleaching applications other than deinking could easily raise this to 10%/year. Nonpaper markets are expected to grow slowly or hold steady.

Capacity will increase also, so no supply problems should occur. FMC is planning a 10,000-tpy expansion at its new Bayport, Texas, facility.

### CANADA

**Uses:** $H_2O_2$ is used to bleach mechanical and chemical pulps and by some mills to replace one or more chlorine dioxide stages if the $ClO_2$ generator is not operating. A relatively new use in one pulp mill is to add a small amount of $H_2O_2$ to the first extraction stage to reduce effluent color. Other uses include textile bleaching and water treatment.

**Demand:** In 1981, the pulp and paper industry will consume 5700 tons of a total demand of 8300 tons, or 68.5%. Other uses include textile bleaching (10%), water treatment (6%), and miscellaneous (15%).

**Sources:** All hydrogen peroxide used in Canada is imported—most from the U.S., and some from Europe (about 20%). Importers include C-I-L, duPont Canada, and Interox, who now ships in directly from Houston.

**Availability:** 1981, market; 1980, market to tight; 1979, market; 1978; market.

**Pricing:** Canadian prices are related directly to U.S. prices, and thus remain at January levels. Currently, the bulk price for 70% solution, f.o.b. producing point, is $1.16/kg (52.2¢/lb). Pricing history: 1980, 95.8¢-1.05¢/kg (43.5¢-47.5¢/lb); 1979, 90.6¢-95.8¢/kg (41¢-43.5¢/lb).

**Forecast:** The growth in thermomechanical pulping (TMP), including expansions of existing mills as well as new facilities, should ensure a steady 10%/year growth in $H_2O_2$ consumption by the pulp and paper industry for the next three years. As capacity expansion peaks in 1985 this could reach 25%/year, but it will drop off to 5% to 10%/year through the end of the decade.

Ontario Paper's expansion at Thorold, Ont., will significantly increase use of recycled newsprint. This in combination with TMP expansions will make it a major $H_2O_2$ consumer by 1983.

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